ELECTROSURGICAL ANALYZER

RF-303

BIO-TEK® INSTRUMENTS, INC.

RF303 Electrosurgical Analyzer

Operator's Manual

Printed in the USA
Manual P/N 3031000
Rev. A
September, 1998

Notices

©Copyright Fluke Corporation
Fluke Biomedical
6920 Seaway Blvd.
Everett, WA 98203
Sales & Customer Service:
775-883-3400 • 800-648-7952

Service and Repair
Please call for RMA number before shipping
1420 75th Street SW
Everett, WA 98203
888-99FLUKE (888-993-5853) • 425-446-5560

http://www.flukebiomedical.com • sales@flukebiomedical.com

All Rights Reserved

This publication is protected by copyright and all rights are reserved. No part of this manual may be reproduced or transmitted in any form, or by means electronic or mechanical, including photocopying and recording, for any purpose other than the purchaser's personal use without the written permission of the product manufacturer.

Restrictions and Liabilities

Information in this document is subject to change, and does not represent a commitment by Bio-Tek® Instruments, Inc. Changes made to the information in this document will be incorporated in new revisions of the publication. No responsibility is assumed by Bio-Tek for the use or reliability of software or equipment that is not supplied by Bio-Tek, or its affiliated dealers.

Trademarks

Bio-Tek® and RF303™ are trademarks of Bio-Tek Instruments, Inc..

Copyright

© Copyright 1998, Bio-Tek Instruments, Incorporated. No part of this publication may be reproduced, transmitted, transcribed, stored in a retrieval system, or translated into any language without the written permission of Bio-Tek Instruments.

Revision History

Revision	Date	Changes
A	September, 1998	Release to production

Introduction

The RF303 will test electrosurgical units (ESU) for generator output and high frequency (HF) leakage. It is compatible with both isolated and earth/ground-referenced types of electrosurgical units. Both the high-level monopolar and the low-level bipolar ESU outputs can be tested using this versatile analyzer.

The RF303 uses a precision high-voltage capacitive attenuator to sample the applied ESU signal. This attenuated HF voltage and the selected test load resistance value are used to derive the true RMS values of both the current in milliamperes (mA) and wattage readings.

The RF303 internal test load simulates the range of resistance encountered during surgical procedures. Additionally, a second, 200 ohm auxiliary test load resistance is built-in to analyze earth/ground-referenced ESUs as specified in the International Standard IEC 601-2-2.

Extraneous high frequency leakages within the analyzer are minimized due to the exclusive use of non-conductive, high-impact plastic material for the analyzer case.

Statement of Intended Use

The RF303 is intended for use by a hospital's biomedical department, third-party service groups, and medical device manufacturers as a routine performance assurance and periodic maintenance analyzer of electrosurgical devices

Safety Considerations
General

This instrument and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

Safety Symbols

	This is the Operating Manual symbol. When you see this symbol on the instrument, refer to the Operating Manual
	This symbol indicates that a terminal is connected to the chassis when such a connection is not apparent
	Alternating current
	Direct current
	Earth ground
WARNING!	The ***"WARNING!"*** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in personal injury. Do not proceed beyond a ***"WARNING!"*** sign until the indicated conditions are fully understood and met.
CAUTION	The **"CAUTION:"** sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the instrument. Do not proceed beyond a **"CAUTION:"** sign until the indicated conditions are fully understood and met.

Applicable Testing Standards

The RF303 has been tested by an independent laboratory and meets the requirements listed here.

Safety Requirements

USA	UL 3101-1, Electrical Equipment for Laboratory Use; Part 1: General Requirements.
Canada	CAN/CSA C22.2 No. 1010.1 (1992), Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use, Part 1: General Requirements.
EC Directive 73/23/EEC	EN 61010–1, Safety requirement for electrical equipment for measurement, control and laboratory use, Part 1: General Requirements.

Technical Requirements

This section lists reference documents for high frequency, surgical equipment inspection.

ANSI / AAMI HF–18-1986	American National Standard for Electrosurgical Devices.
IEC 601-2–2	Medical Electrical Equipment, Part 2: Particular requirements for the safety of high-frequency surgical equipment.
IEC 1289-1	Technical Report-Type 3: High-frequency surgical equipment, Part 1, Operation.
IEC 1289-2	Technical Report-type 3: High-frequency surgical equipment, Part 2, Maintenance

CE Based on the testing standards below, this device bears the CE mark.

Electromagnetic Interference and Susceptibility

EC EMC DIRECTIVE 89/336/EEC

EN 50081-1 Emissions

The system has been type tested by an independent testing laboratory and found to meet the requirements of EC Directive 89/336/EEC for Radiated Emissions and Line Conducted Emissions. Verification was to the limits and methods of EN 55011. The device is classified as EN 55011, Group A.

EN 50082-1 Immunity

The system was also tested and found to meet requirements for Electrostatic Discharge Susceptibility, Radiated Susceptibility, and Electrical Fast Transient/Burst Susceptibility. Verification of compliance was conducted to the limits and methods of EN 50082-1:1992, IEC 1000-4-2; EN 61000-4-3; IEC 1000-4-4; EN 61000-4-5; EN 61000-4-6; EN 61000-4-11.

Safety

EC DIRECTIVE 73/23/EEC

EN 61010–1

Safety requirement for electrical equipment for measurement, control and laboratory use, Part 1: General Requirements.

USA FCC Class A

Warning: Changes or modifications to this unit not expressly approved by the manufacturer could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules.

These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. Like all similar equipment, this equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area could cause interference, in which case the user will be required to correct the interference at his own expense.

Canadian Department of Communications Class A

This digital apparatus does not exceed Class A limits for radio emissions from digital apparatus set out in the Radio Interference Regulations of the Canadian Department of Communications.

Le present appareil numerique n'met pas du bruits radioelectriques depassant les limites applicables aux appareils numerique de la Class A prescrites dans le Reglement sur le brouillage radioelectrique edicte par le ministere des Communications du Canada.

Warranty

This Warranty is limited and applies only to new products, except for computer-based software which is covered under a separate Warranty Policy, manufactured by Bio-Tek® Instruments, Inc. ("Bio-Tek"). Bio-Tek makes no warranty whatsoever regarding the condition of used products.

Bio-Tek warrants the instrument (hereinafter collectively referred to as "Products" or "Product") for a period of one (1) year from the original purchase date against defective materials or workmanship. This Warranty is limited to the original purchaser (the "Purchaser") and cannot be assigned or transferred. All claims under this Limited Warranty must be made in writing to Bio-Tek, Attention: Service Department. Purchaser must ship the Product to Bio-Tek, postage pre-paid. Bio-Tek shall either repair or replace with new or like-new, at its option and without cost to the Purchaser, any Product which in Bio-Tek's sole judgment is defective by reason of defects in the materials or workmanship.

This Warranty is VOID if the Product has been damaged by accident or misuse, or has been damaged by abuse or negligence in the operation or maintenance of the Product, including without limitation unsafe operation, operation by untrained personnel, and failure to perform routine maintenance. This Warranty is VOID if the Product has been repaired or altered by persons not authorized by Bio-Tek, or if the Product has had the serial number altered, effaced, or removed. This Warranty is VOID if any of the Products has not been connected, installed or adjusted strictly in accordance with written directions furnished by Bio-Tek. Batteries, fuses, lightbulbs, and other "consumable" items used in any of the Products are not covered by this Warranty. Software utilized in conjunction with any of the Products is not covered by the terms of this Warranty but may be covered under a separate Bio-Tek software warranty.

We will continue to stock parts for a maximum period of five (5) years after the manufacturer of any equipment has been discontinued. Parts shall include all materials, charts, instructions, diagrams, and accessories that were furnished with the standard models.

THIS WARRANTY CONTAINS THE ENTIRE OBLIGATION OF BIO-TEK INSTRUMENTS, INC., AND NO OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY ARE GIVEN. PURCHASER AGREES TO ASSUME ALL LIABILITY FOR ANY DAMAGES AND/OR BODILY INJURY OR DEATH WHICH MAY RESULT FROM THE USE OR MISUSE OF ANY EQUIPMENT OR INSTRUMENT BY THE PURCHASER, HIS EMPLOYEES, AGENTS, OR CUSTOMERS, OTHER THAN THE EXPRESS WARRANTY CONTAINED HEREIN. WE SHALL NOT BE RESPONSIBLE FOR ANY DIRECT OR CONSEQUENTIAL DAMAGES OF ANY KIND. THIS WARRANTY SHALL NOT BE CHANGED OR MODIFIED IN ANY WAY WITHOUT THE EXPRESS WRITTEN PERMISSION OF AN OFFICER OF BIO-TEK INSTRUMENTS, INC.

Table of Contents

PREFACE III

Notices iii
- All Rights Reserved iv
- Restrictions and Liabilities iv
- Trademarks iv
- Copyright iv
- Revision History v

Introduction vi

Statement of Intended Use vi

Safety Considerations vii
- General vii
- Safety Symbols vii

Applicable Testing Standards viii
- Safety Requirements viii
- Technical Requirements viii
- Electromagnetic Interference and Susceptibility ix
  - EC EMC DIRECTIVE 89/336/EEC ix
- Safety ix
  - EC DIRECTIVE 73/23/EEC ix
- Warranty xi

SPECIFICATIONS 1-1

Inside This Section 1-1

Instrument Specifications 1-3

General Specifications 1-7

Accessories 1-9

INSTRUMENT FAMILIARITY **2-1**

Inside This Section **2-1**

Figure 2-1. RF303 Control and Interface Panels **2-4**

Top Panel Layout **2-5**

Right Side Panel Layout **2-5**

Left Panel Layout **2-6**

INSTALLATION **3-1**

Inside This Section **3-1**

Setting up the RF303 **3-3**

Power-Up Sequence **3-3**
Power-Up Error Condition Codes 3-4

Operating the RF303 Using Battery Power **3-5**
Battery Status Light 3-6

LED Backlight Display Operation **3-7**

Ventilation **3-7**

Connecting Test Leads between the ESU and the Analyzer **3-8**
ESU- Active Safety Lead 3-8
ESU- Dispersive Safety Lead 3-8
ESU Jumper Safety Lead 3-8
ESU CQM Safety Lead 3-9
ESU Case Safety Lead 3-9

OPERATION **4-1**

Inside This Section **4-1**

Safety Precautions **4-2**

Performing Tests **4-4**

Performing the Generator Output Test 4-4
Key to Top Panel Diagrams 4-5
Test Procedures 4-5
Figure 4-1 Diagram of the Generator Output Test 4-8
Performing the HF Leakage Current Test 1 4-9
Test Procedures 4-9
Figure 4-2. Diagram of HF Leakage Test Number One 4-12
Performing the HF Leakage Current Test 2 4-13
Test Procedures 4-13
Figure 4-3. Diagram of HF Leakage Test Number Two 4-16
Test Procedures 4-17
Figure 4-4. Diagram of HF Leakage Test Number Three 4-20
Test Procedures 4-21
Figure 4-5. Diagram of the Basic CQM Check 4-23

Connecting an Oscilloscope to the RF303 4-24
Figure 4-6. Ex. of *Burst* Waveform on Oscilloscope Display 4-24

MAINTENANCE 5-1

Inside This Section 5-1

Cleaning 5-3

Calibration 5-3

Fuses 5-3
Replacing Fuses 5-3
Figure 5-1. Diagram of the Fuse Cover 5-5

ABBREVIATIONS A-1

Inside This Section A-1

Abbreviations A-3

Specifications

Inside This Section

- Instrument Specifications
- General Specifications
- RF303 Accessories

Instrument Specifications

Parameter	Specification/Accuracy
Modes of Operation	• Line Powered (Battery Charge and Maintenance Charge) • Battery Operation • Offline (Battery Charge and Maintenance Charge)
Displayed Parameters	• Power (watts) • HF Current (milliamperes) • Test Load (ohms)
Tests Performed	• Generator Output • HF Leakage Performs HF leakage tests to IEC 601 2–2, 1289–2, ANSI/AAMI standards: *Type BF Test 1*—Earth referenced monopolar output *Type BF Test 2*—Earth referenced monopolar output *Type CF / Bipolar*—Isolated monopolar or bipolar output
Measurement	• Technique: Precision high–voltage capacitive attenuator samples applied ESU signal. This directly measured HF voltage and the selected test load resistance value utilized to derive the true RMS values of both current and wattage readings. • HF Power (watts): Resolution: 1 to 400 W / Resolution: 0.1 W

Parameter	Specification/Accuracy
Measurement (cont'd)	• Maximum power input: 400 W RMS Accuracy: ±5% of reading or ±3 watts, whichever is greater. • HF Current Range: 30 to 2500 mA RMS, Resolution: 1 mA Accuracy: ±2.5% of reading or ±15 mA, whichever is greater.
Bandwidth/ System Response	• Bandwidth of RMS converter circuit (1% accuracy) Flat response: 10 KHz to 10 MHz –3 dB points: 1 KHz to 20 MHz • System Response (measurement circuitry and selected test load): –3 dB points: 1 KHz to 10 MHz @ 300 ohms
Test Load Section	• Main Test Load *Selections:* 15 *Selection range:* 50 to 750 Ω *Step size:* 50 Ω *Duty cycle:* 50% @ 400 W (maximum 30 seconds ON during any one–minute period *Resonance impedance variation:* ±0.5 dB maximum (<10 MHz)

Parameter	Specification/Accuracy
Test Load Section (cont'd)	• Main Test Load (cont'd) • *Accuracy (DC to 500 KHz):* ±4% of selected value measured at calibration to ±1% (across the entire operating temperature range) • *Auxiliary Leakage Test Load* *Fixed:* 200 Ω *Accuracy:* ±4% *Power rating:* 225 W • *Input Capacitance (nominal)* *Active to Dispersive:* 30 pF *Active or Dispersive to Earth ground:* 40 pF
Battery	• *Type:* Sealed lead-acid • *Voltage:* 12 volts nominal • *Capacity:* 2.2 A H • *Field serviceable:* No • *Typical time between recharges:* 2-hour minimum • *Battery cycles:* 200 • *Recharging:* Instrument has internal, automatic charger. No external charger required.
Auxiliary Contact Quality Monitor Testing Feature	The main test load section is used to perform a simple Auxiliary Contact Quality Monitor Testing Feature (CQM) operational check.
Display	• *Type:* LCD, 7–segment • *Display size:* 4 full digits • *Overall display size:* 2.0" x 0.75"

Parameter	Specification/Accuracy
Front–Panel Controls/Push buttons	• *Measurement Select (1)* • *Load Select:* Increment test load (+) one step Decrement test load (–) one step
Top–Panel Input Connections	• *Designations:* Generator output–active (1) Generator output–dispersive (2) Signal earth/ground reference (2) Auxiliary HF leakage load (2) • *Connector type:* 4–mm (0.160″) diameter safety sockets • *Input voltage limit:* 10,000 V peak • *Input current limit:* 3 amperes RMS • *Installation category:* II
Side Input Connection	*Designation:* Signal reference
Oscilloscope Output	• Transformer coupled output • *Scale Factor:* uncalibrated • *Connector Type:* BNC
Calibration Period	Calibration recommended every 12 months.

General Specifications

Parameter	Specification/Accuracy
Temperature Range	• *Operating:* 15° to 35°C • *Storage:* 0° to 50°C
Humidity Range	90% non–condensing
Altitude	to 2,000 meters
Ventilation	• Internal fan with variable speed control • Over temperature detector • Magnetic tachometer sensor to detect blocked fan rotor
Power Requirements	Universal input switching supply (12VDC output) • Operating voltages: *Specified: 115 VAC/230 VAC* *Maximum range: 83 to 264 VAC* • Operating frequencies: *Specified: 50 Hz/60 Hz* *Maximum range: 47 to 63 Hz* • Maximum input requirement: 60 VA • Fusing ***External (user–replaceable):*** • *Quantity: 2* *250 V, 3.15 A, Type F, L1 and L2*
Case Construction	High–impact plastic, UL94-V0
Weight	5.6 Kg (14.15 lb)

Parameter	Specification/Accuracy
Dimensions	15.24 cm H × 34.24 cm W × 30.48 cm D (6.00 in. H × 13.48 in.W × 12.00 in. D)
Intended Use	• Indoor • Installation category 2 • Pollution degree 2 • Portable equipment • Sound levels less than 65 dB A

Accessories

Standard	Bio-Tek Part #
RF303 Operating Manual	3031000
Fuse: Type F, 3.15 A, 250 V	46095
Test Leads:	
1. ESU-Active safety lead with alligator clip (quantity of 1)	48407
2. ESU-Jumper safety lead (1)	48408
3. ESU-Dispersive safety lead (2)	48409
4. ESU-CQM safety lead (1)	48410
5. ESU Case safety lead (1)	48431

Optional	Bio-Tek Part #
Soft Protective Carrying Case	6022012

2

Instrument Familiarity

Inside This Section

- Top Panel Layout
- Right Side Panel Layout
- Left Panel Layout

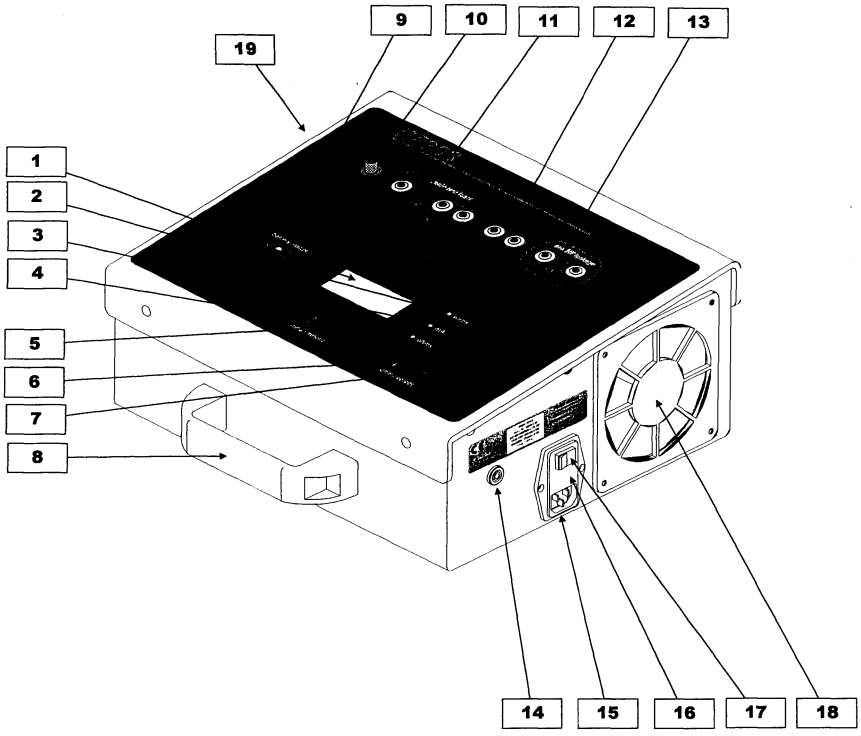


Figure 2-1. RF303 Control and Interface Panels

Top Panel Layout

1. **DISPLAY**—Backlit, numeric, 4-digit LCD
2. **POWER INDICATOR LAMP**—Displays reading in watts.
3. **CURRENT INDICATOR LAMP**—Displays readings in milliamperes (mA).
4. **TEST LOAD LAMP**—Displays resistance in ohms.
5. **MODE SELECTION PUSHBUTTON**—Toggles the display between **Power** (in watts) and **Current** (in mA).
6. **INCREASE TEST LOAD RESISTANCE PUSHBUTTON**.
7. **DECREASE TEST LOAD RESISTANCE PUSHBUTTON**.
8. **CARRYING HANDLE**.
9. **BATTERY STATUS LAMP**
10. **SCOPE OUTPUT**—BNC connector.
11. **MEASURING RESISTANCE/HF METER**—All measurements made through these inputs.
12. **EARTH CONNECTIONS**—Provides earth reference for HF Leakage tests.
13. **HF LOAD RESISTANCE**—Auxiliary test load for earth/ground-referenced Type BF Tests 1 and 2.

Right Side Panel Layout

14. BATTERY GROUND / SIGNAL EARTH GROUND

15. POWER CORD INLET.

16. FUSE COVER—Both power mains fuses are located behind this pane.

17. POWER ON/OFF SWITCH.

18. VENTILATION AIR OUTLET.

Left Panel Layout

19. VENTILATION AIR INLET.

3

Installation

Inside This Section

- Setting up the RF303
- Power-Up Sequence
- Operating the RF303 Using Battery Power
- LED Backlight Display Operation
- Ventilation
- Connecting Test Leads between the ESU and the Analyzer

Setting up the RF303

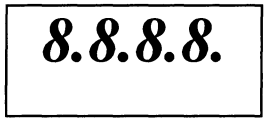
The RF303 has a universal power supply and will automatically operate with applied mains voltages having a maximum range of 83-264 VAC. You do not need to adjust voltage via jumpers or programming tabs in order to operate the analyzer.

Set up the RF303 for operation by attaching the supplied power cord to the power cord inlet located on the right panel of the analyzer case. If necessary, please refer to Chapter 2, *Instrument Familiarity*, for identifying the power cord inlet.

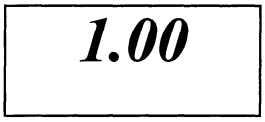
Power-Up Sequence

After plugging the RF303 into a correctly rated earth-ground outlet, locate the power switch on the right panel. Move the switch to the *ON* position (marked with the | symbol). Next you should observe the following power-up sequence:

1. The three front LED indicator lamps illuminate, and you see this information momentarily appear in the display:



2. Next the installed version of the RF303's firmware briefly appears in the display. Here's an example:



3. If the letter *E* followed by a number appears next, this indicates an error condition. See *Power-Up Error Condition Codes* below.

4. After the initialization is complete, the display is blank and the analyzer advances to its default test load condition of 300 ohms, ready to measure ESU power in watts.

Power-Up Error Condition Codes

If in Step 2 above you see the letter *E* followed by a number, this indicates that the RF303 has discovered a problem during its internal self-test. This table shows you all error condition code numbers that could appear in the display and the condition indicated by the code:

RF303 Power-Up Error Condition Codes	
Code Number	Error Condition Indicated
E 03	EPROM checksum wrong
E 04	RAM bad
E 05	EEPROM checksum wrong
E 06	AC-to-DC power converter bad
E 07	RMS converter bad
E 08	Peak detectors bad
E 09	Temperature sensors bad

Operating the RF303 Using Battery Power

You can operate the RF303 using either AC power or DC power. Whenever you power on the analyzer with the supplied AC power cord installed and connected to an appropriate AC power source, the RF303 operates on AC power. Whenever you power on the RF303 with the AC power cord disconnected, the analyzer automatically operates on battery (DC) power.

NOTE: *The battery is a sealed lead-acid type. Do not attempt to replace the battery. Return the RF303 to a service center for replacement of the battery.*

The RF303 contains an internal AC/DC converter. When you operate using AC power, this converter assists in charging the battery, if it is not already fully charged. If the battery is fully charged, it is held in a maintenance float mode.

If you remove the AC power cord while the RF303 is powered on, the analyzer automatically resets in a battery-powered mode. The RF303 can operate on a fully-charged battery for approximately two hours. Battery age, previous battery cycles, and RF303 operating conditions all affect the actual length of time that the analyzer will operate using battery power.

Whenever you have the AC power cord connected from the RF303 to an AC power source and the analyzer is not powered on, the battery charger is active but instrument controls and measurement circuits do not receive power. See the table below for battery operating status under various conditions.

RF303 BATTERY OPERATING STATUS			
RF303 Connected to AC Power Source? (Yes or No)	On/Off Switch set to...	Power Source to RF303 Instrument Controls and Measurement Circuits (AC Power, Battery Power, or None)	Battery Status
No	On	Battery powered	Discharging
No	Off	No power	Open circuit, Minimal leakage.
Yes	Off	No power	Charging
Yes	On	AC	Charging

Battery Status Light

A battery status indicator light is on the RF303's top panel labeled **battery status**. This status light displays the following conditions:

RF303 BATTERY STATUS LIGHT	
Light	Battery Condition
Flashing green	Battery is being qualified (checked) with medium charge or receiving full charge. Voltage is OK.
Steady green	Maintenance charge voltage OK or battery operation with voltage OK.
Flashing red	Battery is supplying power. Voltage is low.
Steady red	Battery failure. Inoperable.

NOTE: *It is highly recommended that the RF303 be charged overnight, when the battery is fully drained.*

LED Backlight Display Operation

The RF303's display is lit any time you select a load or any time a test measurement is received by the instrument.

Ventilation

The RF303 requires proper ventilation so that it does not overheat during operation. Always ensure that the two ventilation ports, one located on each side of the analyzer, are not blocked during use. Maintain at least four inches (10.2 centimeters) of clear space around each of these ports.

An internal fan located immediately behind the grille on the left side port supplies forced-air ventilation. Temperature sensors measure how hot the load resistors are. The fan accelerates as the load temperature increases. The fan rotation is monitored too. If the load temperature is excessive or if the fan is not functioning, an error condition is indicated on the display and the audio transducer emits a beeping sound. The error display codes are:

E 01:Temperature too high.
E 02:Fan not operating.

CAUTION: *Permanent damage to the RF303 can occur if you continue to apply a high-level ESU signal after the alert has been activated.*

Connecting Test Leads between the ESU and the Analyzer

A complete set of test leads is supplied with the analyzer. These test leads are used to connect the ESU generator output to the analyzer and to configure the analyzer to conduct a specific ESU test. Safe connection to the RF303 is facilitated by shrouded safety plugs.

The following is a description of the supplied test leads:

ESU- Active Safety Lead

Part # 48407
Color: Yellow
Quantity: One

One end of test lead has a fixed shroud 4mm banana plug to connect with the analyzer, and the other end has a retractable shroud 4mm banana plug compatible with the active electrode/bipolar jacks on most ESU front panels. A yellow safety alligator clip is included for direct connection to an actual active electrode element if preferred.

ESU- Dispersive Safety Lead

Part # 48409
Color: Blue
Quantity: One

One end of test lead has a single fixed-shroud 4mm banana plug to connect with the analyzer, and the other end has a CQM style two-pin connector which will plug directly into the neutral (or dispersive) electrode jack on most ESU front panels.

NOTE: *The mechanical pin is removed from the CQM connector to disable CQM during ESU generator output tests*

ESU Jumper Safety Lead

Part # 48408
Color: Black
Quantity: Two

Both ends of these two short jumpers have a fixed shroud 4mm banana plug and are used to configure the analyzer for the IEC Type BF Tests 1 & 2 which utilize the auxiliary HF load resistance (200Ω). Both jumpers are required to conduct these tests.

ESU CQM Safety Lead

Part # 48410
Color: Clear/Blue
Quantity: One

One end of test lead has two fixed shroud 4mm banana plugs to connect across the analyzer test load. The other end has a CQM style 2PIN connector that will plug directly into the neutral (or dispersive) electrode jack on most ESU front panels.

NOTE: The mechanical pin is intact to enable the CQM function during CQM testing. Use of this lead is not recommended for output testing.

ESU Case Safety Lead

Part # 48431
Color: Green
Quantity: One

Both ends of the lead have 4 mm safety jacks. A removable green clamp facilitates firm attachment to a ground reference point. This lead is important for making leakage measurements in the battery mode of operation.

Operation

Use this chapter to learn how to use your RF303 for testing electrosurgical units.

Inside This Section

- Safety Precautions
- Performing Tests
- Connecting an Oscilloscope to the RF303

Safety Precautions

When testing electrosurgical units, particular safety precautions should be observed both to ensure operator safety and to maintain the integrity of the high frequency (HF) measurement. To perform the desired surgical effect, the signals from these devices are both high-voltage and high frequency in nature and require special handling by the operator.

- Place the analyzer on an insulated, non-conductive work surface to limit possible HF current paths to earth ground.
- Use the test leads supplied with the analyzer to test the ESU. These test leads are designed to the IEC-1010 safety standard and utilize a shrouded 4mm plug to limit exposure to the high-voltage and high frequency ESU signal. These test leads are one meter in length to limit the coupling of the ESU signal to earth ground. Routinely inspect the test leads for wear and tear. Repair or replace the test leads to maintain operator safety and analyzer performance.
- Whenever practical during testing, activate the ESU generator output using the foot switch supplied with the ESU. Due to their long cables, they may cause erroneously high HF readings when draped across conductive surfaces.

- Whenever practical during testing, place test leads carrying the ESU signals in parallel, approximately 0.5 meters apart, to limit capacitive coupling. Also, avoid crossing or tangling the test leads during use, and do not drape the test leads across any conductive, grounded surfaces.

WARNING! *Do not plug in or remove a test lead from either the ESU or the analyzer while the ESU generator is activated (or keyed). This high frequency ESU signal can be several thousand volts in amplitude when the output is open-circuited.* ***Severe burning or possible cutting of the skin can occur*** *if you do not adhere to safe ESU equipment testing techniques.*

Performing Tests

The sections that follow describe the specific ESU tests you can perform using the RF303. Test procedures prompt you to manually connect test leads in the required configuration. The RF303 does not internally configure the test leads. You can view functional-block diagrams for each test at the end of each test procedure section in this chapter. You can find additional information about test leads in Chapter 3, *Installation.*

NOTE: *The RF303 can test a wide range of electrosurgical units for basic operation and performance. It is compatible with both isolated and earth–ground referenced outputs, and with both monopolar and bipolar outputs. If you have any questions about testing an ESU, you can review* ***Chapter 1, Specifications*** *and the technical service manual for the ESU you want to test. In addition, you can contact your sales representative for additional assistance.*

Performing the Generator Output Test

The analyzer provides an effective method of attaching a resistive test load to the ESU under test and will display the output directly in either watts or HF current of the applied ESU signal. See Figure 4-1 for a diagram of the generator output test at the end of this section.

Key to Top Panel Diagrams

The RF303 uses lights to indicate whether the value displayed in the window represents watts, mA, or ohms. The diagrams in this section resemble the top panel of the RF303. The key is as follows:

○ RF303 panel light is off

● RF303 panel light is on

TEST PROCEDURES

This test involves:

- connecting the ESU you want to test to the RF303
- selecting a test load resistance
- measuring the ESU's power output
- measuring the ESU's current output
- ending the test

To connect the ESU to the RF303:

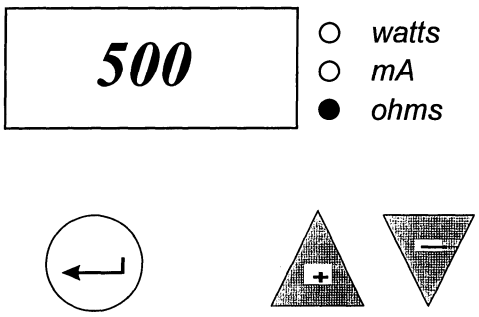
1. Connect the ESU Active/Bipolar-1 electrode to the yellow jack (marked) **active**, using test lead Part # 48407.
2. Connect the ESU Neutral/Dispersive/Bipolar-2 electrode to the left blue jack **dispersive**, using test lead Part # 48409.

NOTE: *The bipolar output may require different test leads to make both connections.*

To select the desired test load resistance:

1. If the indicator lamp **watts** on the top panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.

2. On the top panel, press the **ohms select** increase (+) or decrease (-) buttons until the test load value you want appears in the display. After approximately one (1) second, the value in the display returns to 0.0. Below is an example of a test load value as it appears in the display.



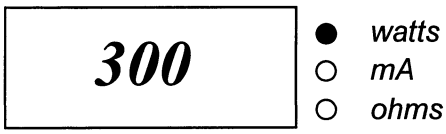
NOTE: For this and all the following diagrams, the key is as follows:

- ○ RF303 panel light is off
- ● RF303 panel light is on

NOTE: The default (or initial power-up) test load selection is 300 ohms.

To measure the ESU's power output:

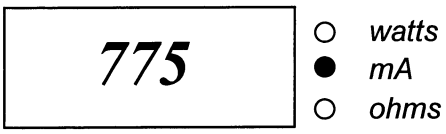
Activate the ESU and view the power measurement on the display. Here is an example:



To measure the ESU's current output:

1. While the ESU is still activated, press **mode select** on the front panel. The milliamperes **mA** indicator lamp will light.

2. View the ESU's current output (in mA). Below is an example.



To end the generator output test:

Deactivate the ESU to end the generator output test.

CAUTION: *Do not exceed the RF303's duty cycle, which is 30 seconds ON during any continuous one-minute period.*

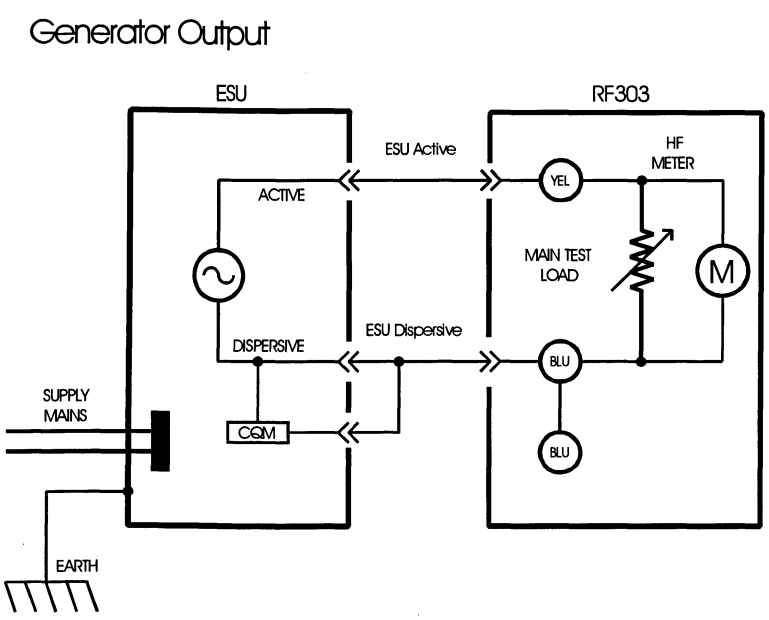


Figure 4-1 Diagram of the Generator Output Test

Performing the HF Leakage Current Test 1

The HF leakage test number one (1) is an IEC earth-referenced, BF-type leakage current test. You perform the test by connecting a 200-ohm resistive test load from the ESU's active electrode to earth/ground on the RF303. High frequency leakage current is then measured through a second 200-ohm resistive load. You can view the resulting measurement on the RF303's display. See Figure 4-2 for a diagram of this test at the end of this section.

TEST PROCEDURES

The procedures involved with this test include:

- connecting the ESU you want to test to the RF303
- selecting a 200-ohm test load resistance
- measuring the ESU's HF leakage current
- ending the test

To connect the ESU to the RF303:

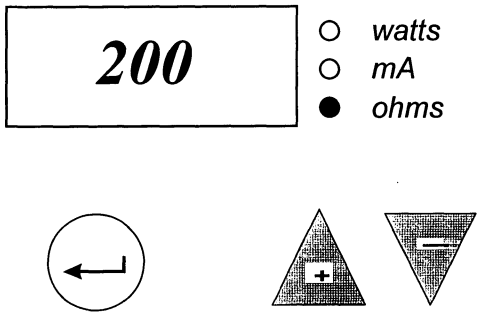
1. Connect the ESU Active electrode to the right gray jack **aux HF leakage**, using test lead Part # 48407.
2. Connect the ESU Neutral/Dispersive electrode to the left blue jack dispersive, using test lead Part # 48409.
3. Connect a jumper between the yellow jack active and the left green jack ground earth reference, using test lead Part # 48408.

4. Connect a jumper between the right blue jack **dispersive** and the left gray jack **aux HF leakage**, using test lead Part # 48408.
5. If operating under battery power, attach a ESU case safety lead (Part # 48431) from the battery ground on the side panel to the ground earth reference.

To select a 200-ohm test load resistance setting:

1. If the indicator lamp watts on the front panel is lit, go to Step 2. If it is not lit, press the mode select button located on the top panel and go to Step 2.

2. On the front panel, push the **ohms select** increase (+) or decrease (-) buttons repeatedly until the test load value 200 appears in the display. After approximately one (1) second, the value in the display returns to 0.0. Below is an example of a test load value as it appears in the display.



To measure the ESU's signal HF leakage:

1. If the indicator lamp **watts** on the front panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.

2. Activate the ESU and view the signal HF leakage measurement on the display. The measurement will be in millamperes. Here is an example.

To end HF leakage test number one:

Deactivate the ESU to end the generator output test.

CAUTION: Do not exceed the RF303's duty cycle, which is 30 seconds ON during any continuous one-minute period.

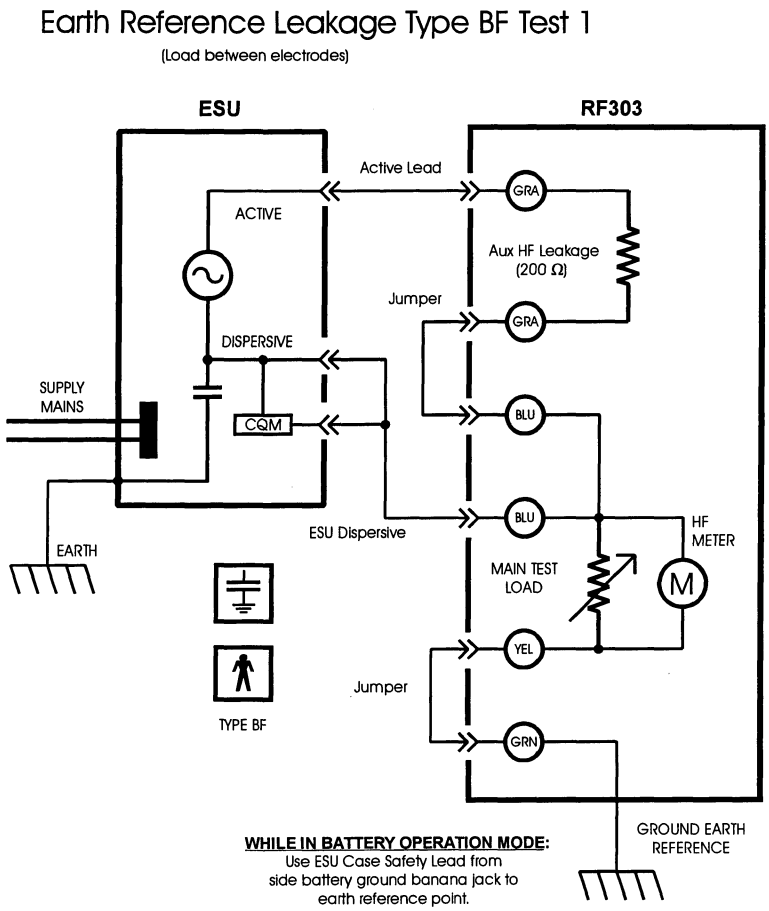


Figure 4-2. Diagram of HF Leakage Test Number One

Performing the HF Leakage Current Test 2

The HF leakage test number two (2) is an IEC earth-referenced, BF-type leakage current test. You perform the test by connecting a 200-ohm resistive test load from the ESU's active electrode to earth/ground on the RF303. Then you connect a second 200-ohm resistive load from the ESU's neutral/dispersive electrode to earth/ground on the RF303. The RF303 then displays the high frequency current leakage from the ESU you're testing. See Figure 4-3 for a diagram of this test at the end of this section.

TEST PROCEDURES

The procedures involved with this test include:

- connecting the ESU you want to test to the RF303
- selecting a 200-ohm test load resistance
- measuring the ESU's HF leakage current
- ending the test

To connect the ESU to the RF303:

1. Connect the ESU Active electrode to the right gray jack **aux HF leakage**, using test lead Part # 48407.
2. Connect the ESU Neutral/Dispersive electrode to yellow jack **active**, using test lead Part # 48409.

3. Connect a jumper between the right blue jack **dispersive** and the left green jack **ground earth reference**, using test lead Part # 48408.

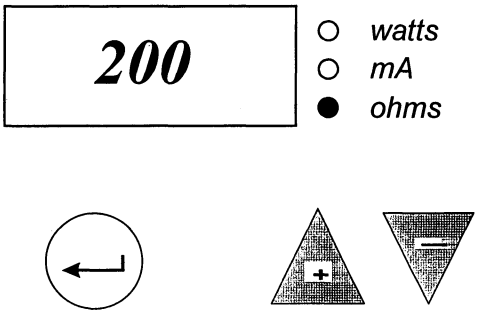
4. Connect a jumper between the right green jack **ground earth reference** and the left gray jack **aux HF leakage**, using test lead Part # 48408.

5. If operating under battery power, attach a ESU case safety lead (Part # 48431) from the battery ground on the side panel to the ground earth reference.

To select a 200-ohm test load resistance setting:

1. If the indicator lamp **watts** on the front panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.

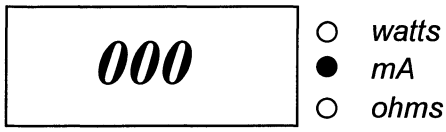
2. On the front panel, press the **ohms select** increase (+) or decrease (-) buttons as needed until the test load value 200 appears in the display. After approximately one (1) second, the value in the display returns to 0.0. Below is an example of a test load value as it appears in the display.



To measure the ESU's signal HF leakage:

1. If the indicator lamp **watts** on the front panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.

2. Activate the ESU and view the signal HF leakage measurement on the display. The measurement will be in millamperes. Here is an example.



To end HF leakage test number two:

Deactivate the ESU to end the generator output test.

CAUTION: *Do not exceed the RF303's duty cycle, which is 30 seconds ON during any continuous one-minute period.*

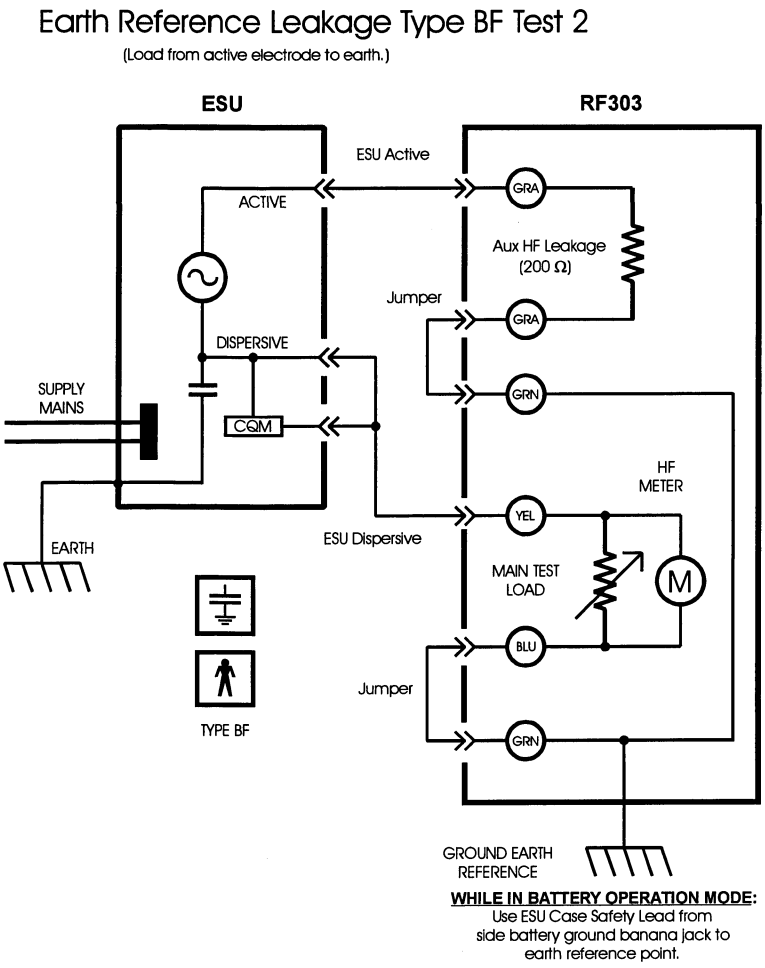


Figure 4-3. Diagram of HF Leakage Test Number Two

Performing the HF Leakage Current Test 3

The HF leakage current test number three (3) is an IEC isolated output/bipolar, CF-type leakage current test. It shows you the amount of open-circuit high frequency current leakage from a single isolated electrode to earth/ground through a 200-ohm resistive test load. See Figure 4-4 for a diagram of this test at the end of this section.

WARNING! This high frequency leakage current test is intended for ***isolated output electrosurgical units only****. If you test the active electrode of an earth-referenced Type BF ESU in the manner described in this section, you will be measuring the full output of the generator, not a high frequency leakage current. While conducting this test inappropriately will not damage the RF303, the resulting high frequency leakage current measurement will not be valid for an earth/ground referenced ESU.*

TEST PROCEDURES

The procedures involved with this test include:

- connecting the ESU electrode you want to test to the RF303
- selecting a 200-ohm test load resistance
- measuring the ESU's HF leakage current
- ending the test

To connect the ESU electrode to the RF303:

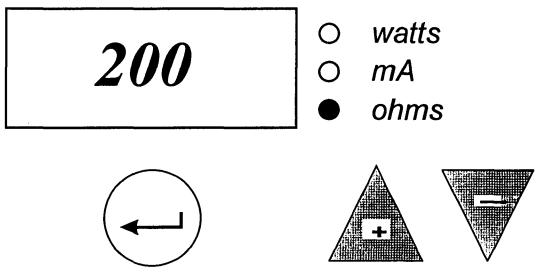
1. If you are testing the ESU's active or single bipolar electrode, connect the electrode to the yellow jack **active**, using test lead Part # 48407, **or**

   If you are testing the ESU's neutral/dispersive electrode, connect that electrode to the yellow jack **active**, using test lead Part # 48409.

2. Connect the jumper between the right blue jack **dispersive** and the left green jack **ground earth reference**, using test lead Part # 48408.
3. If operating under battery power, attach a ESU case safety lead (Part # 48431) from the battery ground on the side panel to the ground earth reference.

To select a 200-ohm test load resistance setting:

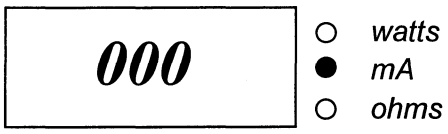
1. If the indicator lamp **watts** on the front panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.
2. On the front panel, press the **ohms select** increase (+) or decrease (-) buttons as needed until the test load value 200 appears in the display. After approximately one (1) second, the value in the display returns to 0.0. Below is an example of a test load value as it appears in the display.



To measure the ESU's signal HF leakage:

1. If the power indicator lamp on the front panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.

2. Activate the ESU and view the signal HF leakage measurement on the display. The measurement will be in millamperes. Here is an example.



To end HF leakage test number two:

Deactivate the ESU to end the generator output test.

CAUTION: Do not exceed the RF303's duty cycle, which is 30 seconds ON during any continuous one-minute period.

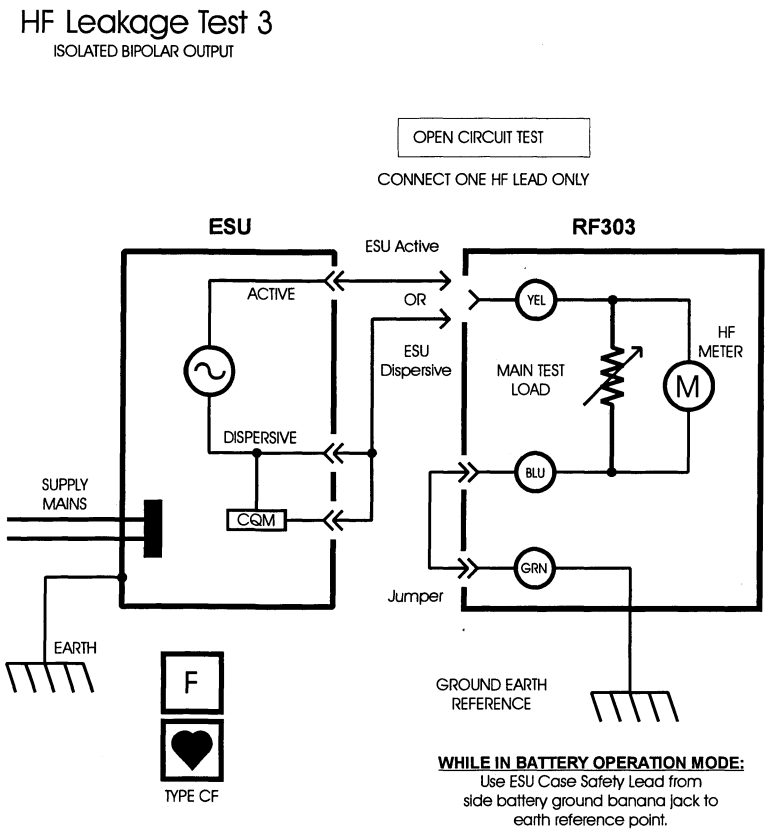


Figure 4-4. Diagram of HF Leakage Test Number Three

Performing the Basic Contact Quality Monitor (CQM) Test

This test of the contact quality monitor uses the RF303's test load to simulate a patient's skin resistance in contact with the dual element neutral/dispersive electrode pad.

NOTE: *Perform this test on electrosurgical units without energizing the generator output. Do not connect the ESU active electrode to the RF303 during this test.*

The CQM (REM) test is intended for the neutral/dispersive electrode of monopolar ESUs equipped with a contact quality monitor. The neutral/dispersive electrode is actually two separate pads attached to the patient's skin. The CQM (REM) circuit should issue an alarm only if the patient loses contact with one or both of the two pads. See Figure 4-5 for a diagram at the end of this section.

TEST PROCEDURES

The procedures involved with this test include:

1. connecting the ESU's neutral/dispersive electrode to the RF303
2. selecting a 50-ohm test load resistance
3. observing the ESU's visual or audio alarm

To connect the ESU's neutral/dispersive electrode to the RF303:

1. Connect one of the two (2) color-coded banana plugs (test lead Part # 48410) to the RF303's yellow jack active.

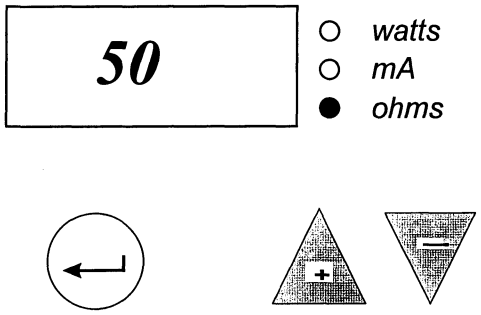
2. Connect the other banana plug to the RF303's left blue jack dispersive.

3. Connect the 2 PIN CQM (REM) connector on the other end of the test lead to the neutral/dispersive electrode of the ESU.

To select a 50-ohm test load resistance setting:

1. If the indicator lamp **watts** on the front panel is lit, go to Step 2. If it is not lit, press the **mode select** button located on the top panel and go to Step 2.

2. On the front panel, press the **ohms select** increase (+) or decrease (-) buttons as needed until the test load value 50 appears in the display. After approximately one (1) second, the value in the display returns to 0.0. Below is an example of a test load value as it appears in the display.



To observe the ESU's visual or audible alarm:

With the 50-ohm test load attached to the ESU CQM (REM) input, it should sense this level of resistance in the "pass zone." Depending upon the ESU device manufacturer, this "pass zone" can extend to 250 ohms. Test load settings over 250 ohms should activate the CQM alarm.

NOTE: Refer to the technical support/service manual of the ESU you are testing for the recommended check-out procedure for the ESU CQM feature.

Increase the test load from 50 ohms until the CQM alarm sounds. The value at that point is the CQM alarm resistance.

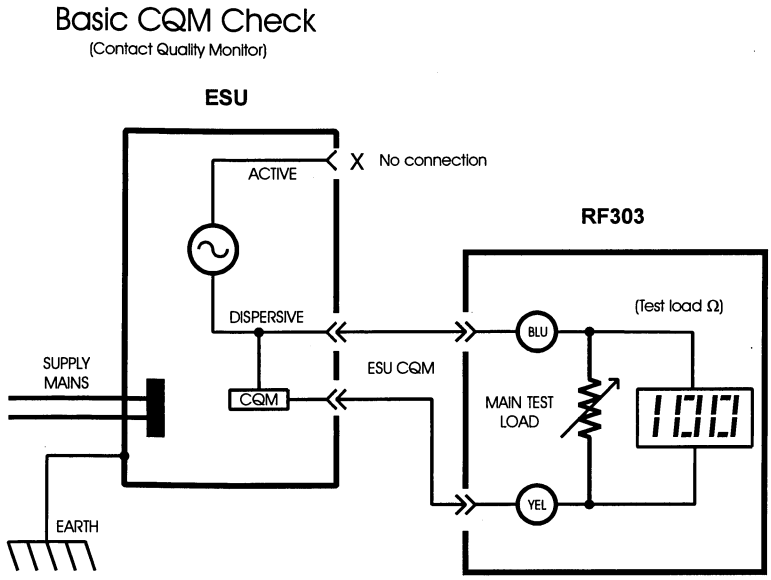


Figure 4-5. Diagram of the Basic CQM Check

Connecting an Oscilloscope to the RF303

You can connect an oscilloscope to the RF303. Connect a standard coaxial cable to the **scope out** BNC connector located on the left side of the top panel. Adjust your oscilloscope in order to view the applied waveform. Look at Figure 4-6 to see a typical *burst* waveform.

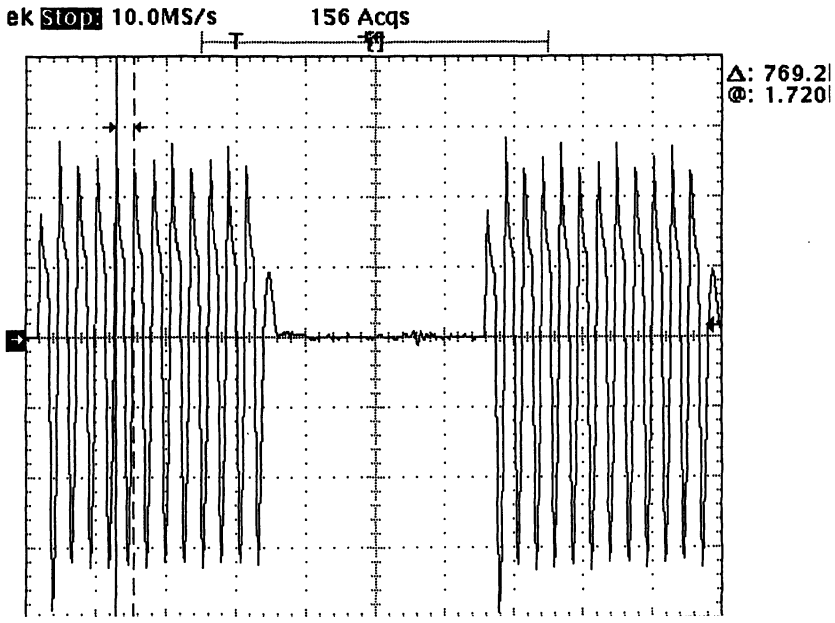


Figure 4-6. Ex. of *Burst* Waveform on Oscilloscope Display

5

Maintenance

Inside This Section

- Cleaning
- Calibration
- Fuses

Cleaning

Clean your RF303 using a mild solution of detergent and water **only**. Moisten a clean cloth with this solution and wipe the RF303 clean.

CAUTION: Using any other solutions to clean your RF303 could result in damage to the analyzer.

Calibration

Calibration is recommended every 12 months.

Fuses

The RF303 contains two (2) operator-replaceable fuses, rated as Type F, 3.15 A, and 250 V.

If you have replaced these fuses and the RF303 still does not work properly, contact the Bio-Tek Technical Assistance Center at 800-24-BIOTK.

Replacing Fuses

The two user-replaceable fuses are in the two mains supply lines. You can replace one or both of these fuses by opening the fuse cover located on the right panel. Refer to Figure 5-1 for a diagram of the fuse cover assembly. If necessary, see Chapter 2, *Instrument Familiarity*, to identify the fuse cover.

WARNING! Disconnect the power source before replacing fuses. Failure to do so may result in severe electrical shock.

1. Disconnect the power cord, and make sure that the power switch is in the *OFF* position. Power is now safely removed from the analyzer.
2. Pry the left side of the fuse cover up from the power inlet assembly, using a small flat-blade screwdriver. The fuse cover is latched on the right and will remain attached to the analyzer.
3. Remove a fuse carrier by lifting it from the power inlet housing, using your fingers. Avoid using sharp instruments to lift the carriers holding the fuses.
4. Replace the fuse in the carrier with one of the same amperage and voltage ratings.
5. Reinstall the fuse carrier into the power inlet module, ensuring that the arrows on the ends of the fuse carriers point up.
6. Close the fuse cover until it snaps into place.
7. Reconnect the power cord, and power on the analyzer if desired.

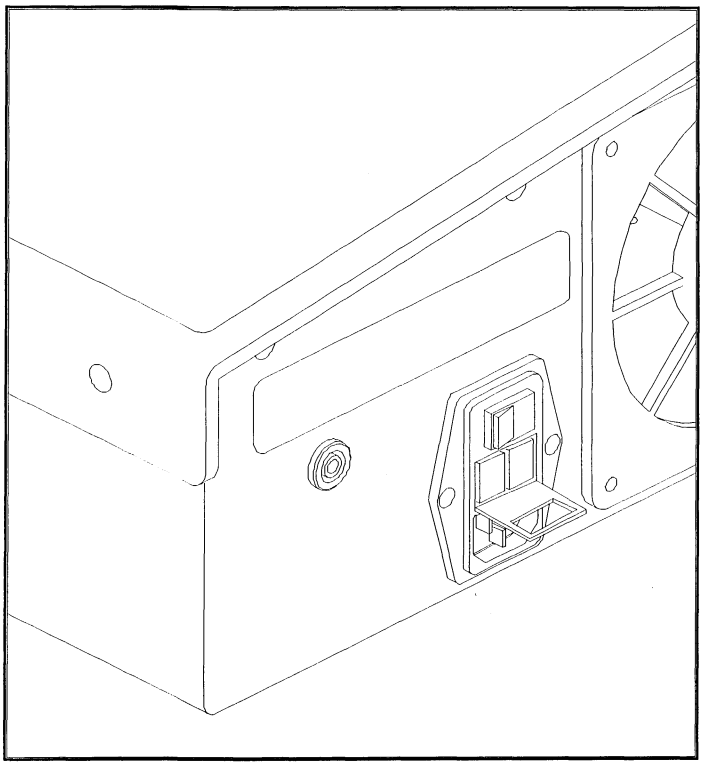
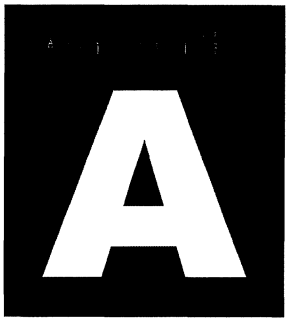


Figure 5-1. Diagram of the Fuse Cover



Abbreviations

Inside This Section

- Abbreviations

Abbreviations

A	ampere
ANSI	American National Standards Institute
AAMI	Association for the Advancement of Medical Instrumentation
BLU	blue (color)
BPM	beats per minute
dB	decibel
°C	degrees Celsius (centigrade)
CQM	Contact Quality Monitor
DMM	digital multimeter
EEPROM	electrically erasable PROM
ECG	electrocardiograph or electrocardiogram
ESU	Electrosurgery Unit
EUT	equipment under test
°F	degrees Fahrenheit
GRA	gray (color)
GRN	green (color)
Hz	hertz
in	inch
K	kilo- (10^3)
Kg	kilogram
KHz	kilohertz
KΩ	kilohm
lb	pound

LED	light-emitting diode
LCD	liquid crystal display
M	meg(a)- (10^6)
MHz	megahertz
MΩ	megohm
m	meter
m	milli- (10^{-3})
mA	milliampere
mm	millimeter
mV	millivolt
p-p	peak-to-peak
REM	Return Electrode Monitor
s	second
YEL	yellow (color)
μ	micro- (10^{-6})
μA	microampere
μV	microvolt
Ω	ohm

RF-303